product platforms

Marc H. Meyer, Olivier de Weck and Tucker Marion

Basic Definitions

It has been shown that a key to success is to leverage existing know-how and assets across existing products as well as new market applications (Meyer, Tertzakian, and Utterback, 1997). Designing, developing, and integrating "product platforms" is a tried and true practice for accomplishing that end (Meyer and Lehnerd, 1997). We first define the meaning and context for product platforms in new-product development, and then provide a method for planning product platforms and linking them to current or new-product portfolios.

Definitions for product platforming are very important because "platform" is now used in so many different ways. To establish a meaning that we find most useful in the practice of new-product line development, let us begin with• Figure 1. That figure provides an approach for leveraging product platforms to current and new market applications in the form of distinct product lines with specific products (*see* PRODUCT LINE MANAGEMENT).

Q1

wiem05039

Market segments and applications. At the top of the figure is a representation of a firm's current and potential target market segments, with a range of distinct *market applications*. A market segment is a specific group of users, made specific by virtue of classic segmentation criteria (geographic location, income level, gender, or industry affiliation) and behavior criteria (a high-performance user versus a price buyer, for example). Market applications are formed by applying potential product *uses* against these different users. A market application is therefore the intersection of specific groups of *users* and specific types of product *uses*.

In the figure, different market applications are labeled A, B, C, and D. Each represents distinctly different needs and user preferences and mainly requires different functionality in some shape or form in the products or services designed to address the target applications.

To illustrate, an automobile manufacturer can segment potential users in terms of age, gender, and family status – for example, as families, mature professionals, or young adults. These users then have different product uses: family driving, commuting to work, driving as part of a trade, or driving for social experience (the youth market). From the intersection of these users and uses come specific market applications: a family van, an upscale commuter car, a pickup truck, and/or a stylish SUV• designed for Gen Y.

Q2

Product portfolio. The aggregation of all the products within the product lines intended to address a firm's target market applications can be referred to as the firm's *product portfolio* (Wheelwright and Clark, 1992; McGrath, 2002•) (*see also* PORTFOLIO MANAGEMENT).

wiem05006
Q3

In Figure 1, the product portfolio contains all the specific product variations within the product lines serving market applications A, B, C, and D. The product portfolio specifies different product offerings, typically at different price points, for different target applications – with an eye on beating competition, increasing demand, and achieving overall operating profit. These specific offerings can be arrayed on the same market segmentation grid. Rather than just "A" in the figure, a firm might offer several or more specific products for a specific market application. The firm might also not play in that market space because of competitive intensity or lack of market knowledge. Staging an entry into specific market applications over a period of years is another possibility.

Creating robust product portfolios requires deep insight into the needs, preferences, and aspirations of different potential types of customers (*see* VOICE OF THE CUSTOMER). The marketing goal• of effective portfolio planning is that each element of the product portfolio brings delight to each specific target user and his/her intended product use along the price/performance/feature or capability continuum. Portfolio planning should also establish the clear streams of revenue derived from specific product offerings for target market applications. In other words, the product portfolio becomes a revenue map.

wiem05020
Q4

2 product platforms

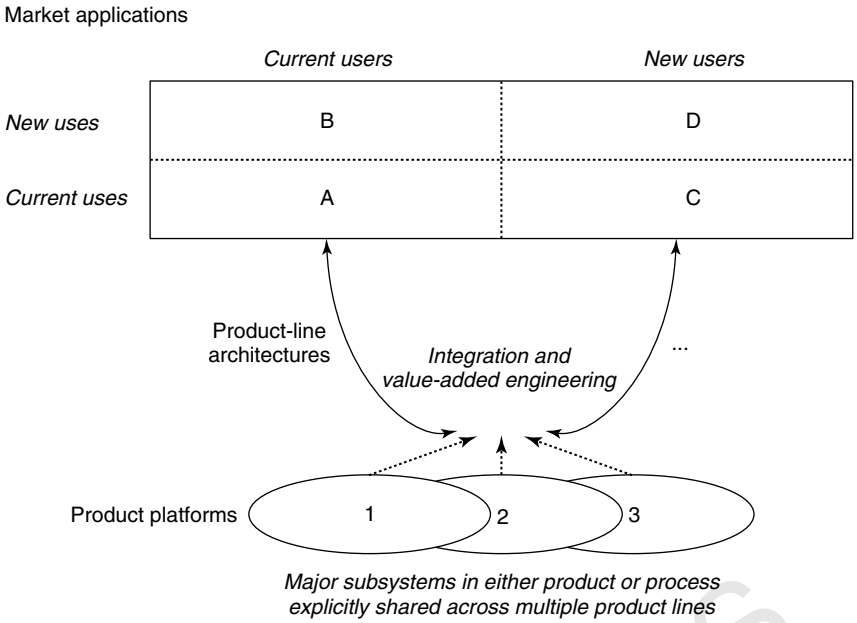

Figure 1 Leveraging platforms to new market applications.

Product-line architecture. Figure 1 also represents a firm that applies major common subsystems to its different market applications. An example might be a common engine across different passenger automobiles and sports utility vehicles (Honda), or a common database management system serving different software modules within enterprise bookkeeping and customer management (SAP●). The ability to leverage these common subsystems relies on a clear architecture for each product within the product portfolio. That architecture defines not only all the subsystems but also the interfaces between these subsystems.

Q5

Robust product-line architecture allows an engineering team to combine subsystems common to the entire product line with subsystems that are unique to specific product variations in a manner that is both effective and efficient. It also allows a team to produce different levels of functionality within the product line without reengineering each individual offering – typically seen as "good, better, best" variations derived from the same product-line architecture (Meyer and Lehnerd, 1997). In addition, a product-line architecture may in fact span multiple market applications – A, B, C, and D taken as whole in Figure 1 – or each market application may require its own unique product-line architecture.

In Figure 1, we show two● product-line architectures, labeled *alpha* and *beta*. These represent distinct configurations of subsystems and the interfaces between those subsystems required for the overall construction or assembly of products created from the product-line architecture. Continuing our example, Honda has distinct product architectures serving its Civic and Accord product lines, and another product-line architecture for its entry level SUVs, its large SUVs, and its minivans. A firm must periodically renew its product-line architectures to incorporate new technology breakthrough – such as using new hybrid engine technology in passenger cars.

Q6

Product platforms. *Product platforms* shown in the Figure 1 as 1, 2, and 3 represent specific modules of functionality. These are modules used within and across different product-line architectures. A single subsystem shared across

multiple products is considered a product platform, and across multiple product lines, truly powerful and robust. A product platform is an operational building block for a range of final products. For example, when a razor manufacturer develops a shaving blade of the same dimensions, coating, and edge for different products, it has created a powerful product platform. The same •user interface across a suite of software products delights the user, simplifies training, and decreases switching costs (Cooper, 2004).

A product platform can also be an interface between different subsystems within a product-line or multiple product-line architectures. In software, .Net is a product platform enabling distributed computing in Microsoft's own operating systems, database, portal, and content management tools, its Office application suite, and third-party software products. Common product platforms – the core subsystems within an architecture and the interface between these and other nonshared subsystems – lead to efficient use of engineering resources, economies in materials purchase, and more rapid cycle time for developing new products that can use the common building blocks.

Process platforms. The manufacture, assembly, or fulfillment •of a product platform is typically creating from a shared asset that is used to produce different specific products within a product line (*see also* PROCESS INNOVATION). That shared asset may be considered a *process platform*. Common process platforms lead to substantial advantages in terms of capital for plant and equipment (where costs are shared across multiple product lines), as well as efficiency and learning in actual production. For example, Honda uses the same assembly line for manufacturing its Civics passenger lines and Element sport utility vehicle; and Mars, Inc. produces its heart-healthy CocoaVia chocolate bars on the same manufacturing asset as its Kudos snack bar (Meyer, 2007). Flexibility in the shared manufacturing asset to produce different configurations is an essential design goal (Hauser and de Weck, 2006).

Working with Product Platforms: Defining Fixed Points and Flex Points Within a Product-Line Architecture

Figure 2 shows how a team can think about the combination of product platforms with other subsystems within a product-line architecture. In the figure, each product line has its own distinct product-line architecture (defined as the major subsystems and interfaces that are the foundations of all the specific products within that product line of business). Over time, that architecture evolves to meet new user requirements and embrace new core technology. In the figure, that architecture is depicted as layers of subsystem technology – some common, others unique, to specific product lines within the product portfolio.

In platform-focused firms, the value-added engineering performed for individual products is a portion of the total engineering effort, because the most of the technology for single products comes from common existing platforms. The power of the platform discipline •occurs when a substantial percentage of all the modules within and between product-line architectures are common. There can be cases where the degree of commonality is 100%, and variation for different groups of customers is achieved through *services* provided with the product. However, it has also been shown that taking platforming too high up the stack can make differently branded products look and function all too much alike• – saving on cost of goods but disappointing users (Simpson, 2004). The more typical scenario, however, is that half or more of the engineering required for a new-product development within an established product line is achieved by the integration of preexisting subsystems based on preexisting interfaces.

With time, the functionality, performance, and cost of common subsystems are improved by the firm itself or its suppliers. Robust interface design allows engineers to migrate to increasingly powerful generations of subsystem technology without violating the overall product-line architecture. The ability to replace aging components with newer, better ones comes from effective technology roadmapping (Albright and Kappel, 2002).

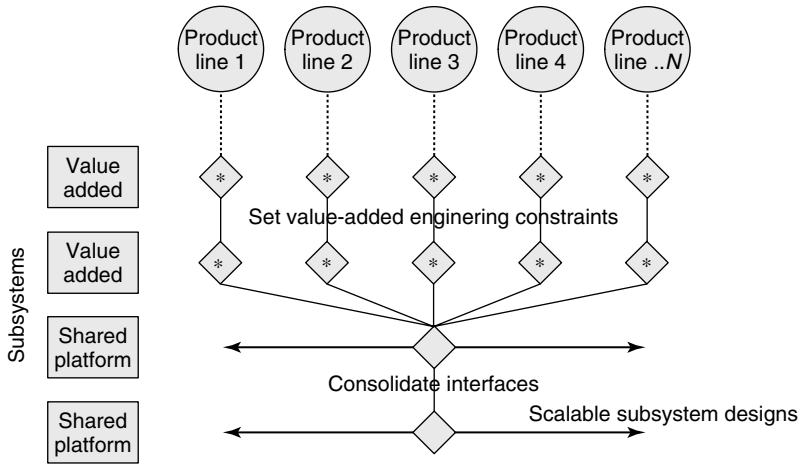

Figure 2 Fix points and flex points in design: combining common product platforms with unique subsystems.

Interface discipline is essential for successful product platforming (Boothroyd and Dewhurst, 1987; Sundgren, 1995; Cooper, 2004; Meyer and Webb, 2005). This concept is represented by the words *single channel interfaces to and from subsystems* in Figure 2. This means one clear method or process for connecting to that subsystem from any other subsystem, clearly documented and strongly enforced. Unfortunately, as engineers add new functionality to other subsystems, they also tend to create new custom interfaces between these subsystems. Over time, a multiplicity of interfaces becomes a tremendous impediment to the innovation of a new subsystem and a value-added product development. Without interface discipline, it becomes increasingly expensive to make even the most incremental of product improvements. On the other hand, robust interface design can enable greater levels of product variation at minimal cost. For example, earthmoving equipment manufacturers, such as Caterpillar, have designed flexible coupling devices to rapidly attach different work tools (buckets, hammers, and forklifts) to the same machine – such as a backhoe loader.

Planning for Scalability in Product and Process Platforms

The primary design requirement for a product or process platform must be the flexibility to fit within different product-line architectures, and scalability, to support increasingly powerful products. This enables a firm to efficiently leverage these common modules – its product platforms and the production processes for them – to new market applications. The process of mapping specific product platforms, with varying levels of functionality, to specific products is well described by Thomson and Broms (2000•) with the example of how Scania designs its trucks. Q11

Defining the range of functionality for a common subsystem or interface, for example, the product platform, requires that a team first have a working definition of the product portfolio. That portfolio may include all the products planned with a single product line, or all the products planned for multiple product lines depending on the scope and focus of the development initiative (as represented earlier in Figure 1). With the portfolio in hand, the team must then carefully study user requirements in terms of performance, other types of functionality, and cost – typically arrayed as levels of performance/price within the product line(s) serving the target applications. These functionality requirements (*see* PRODUCT SPECIFICATIONS) may be strikingly different for different markets – male versus female; developed country• versus emerging market; enterprise software versus home-use software market. With requirements in hand, the team wiem05049 Q12

can then design its product platforms to serve its target applications. By achieving this, the team creates a *scalable* product platform (de Weck, 2006).

Figure 3 shows one classic instantiation of engineering a scalable product platform – in this case, a common motor that could deliver a broad range of power based on varying wire stack length, and which served levels of "good, better, best" for Black and Decker's drills, sanders, jig saws, circular saws, and other major power tools product lines. Figure 4 shows a more recent example, Honda's family of engines that have served "good, better, best" versions of both its passenger cars and sports utility vehicles. Scalable product platforms such as these, and their associated high-volume manufacturing processes, are powerful enablers to reduce cost of goods on a per unit basis and to meet rapidly expanding levels of demand for products in the line.

Product Platforms Have Implications Beyond Product and Technology

Making the business case for product platforms is increasingly important in resource-constrained business environments where the benefits of a platform program must be weighed against more traditional single-product developments. Experience has shown that in many industries, it is initially more expensive to design and develop a robust, scalable product platform and its associated manufacturing processes. To be able to justify the benefit of the platform effort to the business, a team must develop a business case.

The business plan for platforming should aggregate operating profits projected for all products in the platform-based portfolio and use these aggregated sums in net present value and/or ROI• calculations. A team might find, for example, that the investment required to develop platforms might be more than covered by the lower cost of goods from such

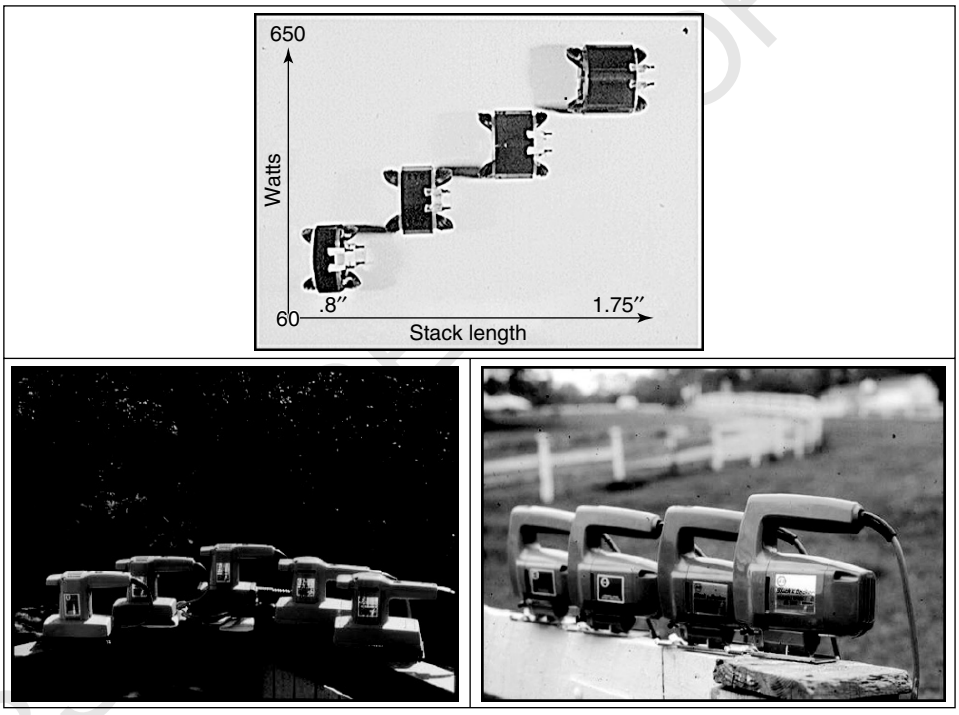

Figure 3 Black and Decker achieves magic with its scalable motors – the product platform shown incorporated in two of many product lines (reprinted from Meyer and Lehnerd, *The Power of Product Platforms*, 2007).

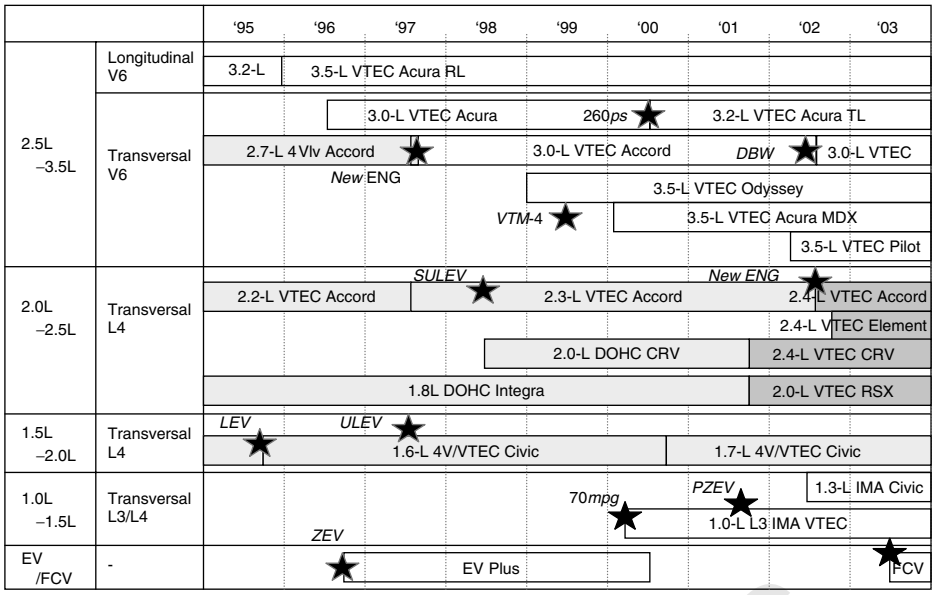

Figure 4 An engine for growth in Honda: a road map of common power trains from 1995 to 2003 (reproduced with permission from Honda Motor Company, Ltd., reprinted from Meyer, The Fast Path to Corporate Growth 2007).

commonality. However, arriving at this type of detailed understanding of material and conversion costs for platform-based product lines requires a dedicated effort to do well. Clearly, a platform-planning team should include individuals with strong financial acumen who know how to gather cost information and integrate these with pro forma income statements and capital plans.

Breaking cost barriers typically requires a team to challenge the conventional thinking within the company in terms of manufacturing processes and suppliers. If a team is bold •in its thinking, it can deliver more powerful products at lesser cost than the firm's current offerings, and its proposal to senior management becomes much more attractive. For example, it can recommend lower market prices for its new products, increasing market share or in fact enlarging the current market to generate substantially greater revenue. Or, a team might recommend maintaining current market share and more slowly growing revenues, but substantially improved gross margin. Regardless of the final business-case approach, we encourage all platform teams not to simply seek product parity at lower cost, but rather, *to create better products that can also be produced at lower cost*. This helps achieve *value-cost leadership*, a foundation for sustained success (Meyer and Lehnerd, 1997).

Product platforms can also help a firm reconsider its business model. First, traditional premium manufacturers can apply platforming to lower their manufacturing costs, providing new mid-range or perhaps even low-end product offerings to match competition from offshore companies with lower labor costs. Many companies are at present considering platforming as a response to low-cost competitors who are scaling up their products to compete in mainstream markets. Second, platforming – particularly in software products – allows firms to create new streams of recurring revenue enabling plug-in modules for the installed base. Third, platforms can have beneficial effects for a firm's service business. Rather than training service staff on the inner workings of the many different subsystems and interfaces across an entire portfolio, a product line with shared subsystems allows economies in training and service delivery. Lastly, the design of services can themselves be platformed

wiem05016 (*see* SERVICE INNOVATION MANAGEMENT), focusing on common processes and measurements of quality and cost for those processes (Meyer and Detore, 2000●).

Q15

A business case must also consider that well-designed product and process platforms enable future innovation by providing a stable base upon which technology could be applied to create new market applications. Modifying the "flex points" and leveraging the "fixed points" within a product-line architecture is the key to creating niche-focused products at little cost and readying them for market testing. While one cannot fully anticipate the range of product variations in future years, the flexibility to respond to market opportunities should interest any forward thinking senior management team. Creating rich variety from simple means is a grounding principle of platform strategy.

There are, of course, many inspirational examples of successful platform management leading to business success. These include Honda, the different vehicles of which share power trains, and Boeing, whose 787 Dreamliner leverages scalable frame, cockpit, and interior subsystem technology across a broad range of formerly separate aircraft. Apple is another fine example. The iPOD, iTouch, and iPhone products share common operating systems and applications software platforms – including iTunes. Apple also broke tradition by making its iTunes software operational on Windows-based computers to broaden market reach. Aspiring to be like Honda, or Boeing, or Apple, however, is of directional value only; it is up to each company to determine how these principles apply best to its own specific situation. There are no short cuts.

To sum up, product platforms have intriguing implications that go well beyond products and technology. Readers must consider these to achieve business as well as technical success. Books such as *The Fast Path to Corporate Growth* (2007) and *Product Platform and Product Family Design: Methods and Applications* (2006) provide detailed methods for platforming new product lines and many examples of success.

Bibliography

Albright, R. and Kappel, T. (2002) Roadmapping in the corporation. *Research-Technology Management*, **42** (2), 31–40.

Boothroyd, G. and Dewhurst, P. (1987) *Product Design for Assembly*, Boothroyd & Dewherst, Inc., Wakefield.

Cooper, A. (2004) *The Inmates are Running the Asylum*, Sams Publishing, Indianapolis.

Hauser, D. and de Weck, O.L. (2006) Flexible parts manufacturing systems: framework and case study●. *Journal of Intelligent Manufacturing*.

Q16

Johnson, H.T. and Broms, A. (2000) *Profit Beyond Measure*, The Free Press, New York.

McGrath, M. (2002) *Product Strategy for High Technology Companies*, McGraw-Hill, New York.

Meyer, M.H. (2007) *The Fast Path to Corporate Growth: Leveraging Platforms to New Market Applications*, Oxford University Press, New York.

Meyer, M. and Lehnerd, L. (1997) *The Power of Product Platforms*, The Free Press, New York.

Meyer, M.H., Tertzakian, P., and Utterback, J. (1997) Metrics for managing product development within a product family context. *Management Science*, **43** (1), 88–111.

Meyer, M.H. and Webb, P. (2005) Modular, layered architecture: the necessary foundation for effective mass customization in software. *International Journal of Mass Customization*, **1** (1), 14–36.

Simpson, T.W. (2004) Product platform design and customization: status and promise. *Artificial Intelligence for Engineering Design*, **18**, 3–20.

Sundgren, N. (1995) Introducing interface management in new product family development. *Journal of-Product Innovation Management*, **16**, 40–51.

de Weck, O. (2006) Determining product platform extent, in *Product Platform and Product Family Design: Methods and Applications* (eds T.W. Simpson, Z. Siddique, and J. Jiao), Springer, New York, pp. 241–301.

Wheelwright, S. and Clark, K. (1992) *Revolutionizing New Product Development*, The Free Press, New York.

Please note that the abstract and keywords will not be included in the printed book, but are required for the online presentation of this book which will be published on Wiley's own online publishing platform.

If the abstract and keywords are not present below, please take this opportunity to add them now.
The abstract should be a short paragraph upto 200 words in length and keywords between 5 to 10 words.

Author names(s) and affiliation(s) will appear, as listed below, in a List of Contributors in the front of the print edition and will also appear in the online version of the book. Please check that the names(s) and affiliation(s) given below are correct and that you (and any co-authors) are happy for this information to appear both in the printed book and in the online version.

Q17

Abstract: This article presents definitions• for market segments and market applications, product portfolios, and product and process platforms. It also provides methods for planning product architecture and product platforms within that architecture.

Keywords: product portfolio; product platforms; product–line architecture

Author(s) and Affiliation(s):

Marc H. Meyer
Northeastern University, Boston, MA, USA

Olivier de Weck
Northeastern University, Boston, MA, USA

Tucker Marion
Northeastern University, Boston, MA, USA

Author Queries

Q1. Please provide high resolution figures for this article.

Q2. Please confirm if this abbreviation 'SUV' needs to be spelt out. If yes, please provide the expansion.

Q3. Please confirm if this year should be 2000 or 2002.

Q4. In "The marketing goal of effective portfolio planning..." and in one more instance may we change the word "delight" to "complete satisfaction"?

Q5. Please confirm if this abbreviation 'SAP' needs to be spelt out. If yes, please provide the expansion.

Q6. In "In Figure 1, we show two product product-line architectures, labeled alpha and beta" the labels alpha and beta have been mentioned. These are nor indicated in Figure 1 as stated. Please clarify.

Q7. We have modified "The same user interface across a suite of software products delights the user, simplifies training, and increases switching costs (Cooper, 2004)." as "The same user interface across a suite of software products delights the user, simplifies training, and decreases switching costs (Cooper, 2004).". Please confirm if this is fine. Please also clarify if we may change the word "delights" to "brings complete satisfaction to".

Q8. May we modify "The manufacture, assembly, or fulfillment of a product platform is typically creating from a shared asset that is used to product different specific products within a product line (see also wiem05050)" as "The manufacture, assembly, or fulfillment of a product platform is typically creating a shared asset that is used to produce different specific products within a product line (see also wiem05050)"?

Q9. In "The power of the platform discipline occurs when a substantial percentage of all the modules within and between product line architectures are common." may we change "occurs" to "becomes evident"?

Q10. In "However, it has also been shown that taking platforming too high up the stack can make differently branded products look and function all too much alike" may we change the words "too much alike" to "too similarly"?

Q11. The reference Thomson and Broms (2000) has not been listed in the reference list. Please provide the reference details.

Q12. We have modified the segment " male versus female; developed country versus emerging market; enterprise software versus home market." as " male versus female; developed country versus emerging market; enterprise software versus home-use software market.". Please confirm if this is fine.

Q13. Please confirm if this abbreviation 'ROI' needs to be spelt out. If yes, please provide the expansion.

Q14. We have modified " Be bold! If a can deliver more powerful products at lesser cost than the firms current offerings, its proposal to senior management becomes much more attractive." as " If a team is bold in its thinking, it can deliver more powerful products at lesser cost than the firms current offerings, and its proposal to senior management becomes much more attractive." Please confirm if this is fine.

Q15. The reference Meyer and Detore (2000) has not been listed in the reference list. Please provide the reference details.

Q16. Please provide the volume number and page range for reference Hauser and de Weck (2006).

Q17. Please provide at least 5 keywords in all for this article.